FAA-E-2492/2a
AMENDMENT 1
May 15, 1978

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
SPECIFICATION

TURNKEY FACILITY ESTABLISHMENT FOR INSTRUMENT LANDING SYSTEMS
PART 2, SYSTEM REQUIREMENTS

Page 5, paragraph 2-2.3.1.- To the list of ASTM standards add the following:

"ASTM A 123	Zinc (Hot Galvanized) Coatings on Products Fabricated from Rolled, Pressed and Forged Steel Shapes, Plates, Bars and Strip
ASTM A 153	Zinc Coating (Hot Dip) on Iron and Steel Hardware"

Page 10, paragraph 2-3.3.2.- In the first sentence change "a predetermined position" to "the correct setting if the control is temporarily maladjusted." To the existing text add, "Scale markings and locking devices shall be provided as a minimum for the following controls and shall be such as to allow return of the control to its previous position with the appropriate parameters repeatable to the accuracies indicated regardless of the direction of adjustment.

a) Localizer Carrier Modulation (2-3.4.3.2.12)	± 0.5 percent
b) Localizer Modulation Balance (2-3.4.3.2.13)	± 0.002 ddm
c) Localizer Sideband Amplitude (2-3.4.3.2.14)	± 0.2 dB

d)	Localizer, RF Phaser (2-3.4.3.2.15)	± 3.0 degrees electrical
e)	Glide Slope, Carrier Modulation (2-3.4.4.3.12)	± 0.5 percent
f)	Glide Slope Modulation Balance (2-3.4.4.3.13)	± 0.002 ddm
g)	Glide Slope, Sideband Amplitude (2-3.4.4.3.14)	± 0.2 dB
h)	Glide Slope, RF Phaser (2-3.4.4.3.15)	± 3.0 degrees electrical
i)	Sideband Reference Phaser (2-3.4.4.4.1)	± 3.0 degrees electrical
j)	Sideband Reference Amplitude Control (2-3.4.4.4.2)	± 0.2 dB
k)	Capture Effect Phasers (2-3.4.4.5.1)	
	Lower and Middle Antennas	± 2.0 degrees electrical
	Upper Antenna	± 4.0 degrees electrical

Page 11, paragraph 2-3.3.7.1- In the first sentence change "glide slope and marker beacon" to "and glide slope." In the second sentence after "shelters" insert "and the marker beacon station equipment".

Page 11, paragraph 2-3.3.9.- Delete all text after "test probes and test equipment". After existing text add the following:

"For the purpose of maintenance checks an in-line phasing detector (2-3.4.3.3) signal with a 90/150 composite audio level compatible with the input requirements of the portable ILS reciever (2-3.6) shall be available at standard ¼ inch phone jacks in a readily accessible position located within the shelter, and labeled "Phasing detector"."

Page 13, paragraph 2-3.3.17.- Delete the first sentence in its entirety and substitute "Colors of the ILS localizer and glide slope shelter exterior surfaces shall be aviation orange, color 12197, and insignia white, color 17875, in accordance with FED-STD-585 arranged in either a pattern of alternate vertical bands or a checkerboard pattern." Delete the last sentence and substitute the following therefor:

"Steel skids or framework under the shelter shall be hot dipped galvanized after fabrication in accordance with ASTM A 123 for structural steel and in accordance with ASTM A 153 for hardware. "

Page 13, paragraph 2-3.3.19.- In the first sentence delete "a water borne preservative full length treated Class 1 wood pole meeting or exceeding the requirements set forth in FAA specification FAA-E-113 or it shall be". In the last sentence delete the word "fabrication".

Page 14, paragraph 2-3.3.20.- Delete the period at the end of the last sentence and add the following new text "or with any or all RF outputs terminated in an open circuit or a short circuit for any indefinite period of time".

Page 14.- Add the following new paragraphs:

"2-3.3.21 Transient Protection.- The equipment shall withstand induced transients on any ungrounded ac powerline, communication, control, or monitor line entering or leaving the station. For this purpose, protection shall be provided for transients having the characteristics as specified in Table I.

TABLE I

TRANSIENT CHARACTERISTICS

Peak Voltage	Rise Time (10%-90%	Decay Time (Exponential to Half Amplitude)	Minimum Energy Level Per Pulse
a. 2000V	10 usec	50 usec	8 Joules
b. 1000V	10 usec	1000 usec	28 Joules
c. 400V	10 usec	4000 usec	25 Joules
d. 1000V	10 usec	100 usec	4 Joules

The equipment shall withstand repetitive exposure to transient variations, as specified in 2-3.3.21.1 and 2-3.3.21.2 without failure of the protection devices and without damage to the ILS equipment. Transients requiring specific isolation include induced voltage impulses from nearby lightning strikes and surges occurring on the primary electrical feeders as a result of lightning or the switching of heavy reactive loads elsewhere in the utility power system. Maximum use shall be made of no fault devices which shunt transients to ground without causing failure of equipment or protective devices. Circuit design and protective devices shall be selected, assuming a maximum system ground condition equal to or less than 25 ohms. The equipment shall not suffer physical damage while being subjected to the transient testing specified herein and the operational characteristics shall return to initial conditions

immediately after the transient testing is completed. The pulse generator equipment used shall have an output impedance not to exceed 2.5 ohms and be capable of providing the pulse shapes specified in Table I when applied to a 25-ohm resistive load. Pulse shapes need not be maintained when testing equipment (i.e., distortion due to load impedances of other than 25 ohms is tolerable); however, pulse energy input to the equipment under test shall remain as specified in Table I.

2-3.3.21.1 Powerline Transients.- Using pulses a and b of Table I (2-3.3.21) the following transients shall be applied to each equipment powerline:

a. A single pulse applied a minimum of six times in succession at a rate not to exceed 1 Hz.

b. A single burst of pulses (consisting of a minimum of 40 pulses at a PRF of 10 Hz) applied a minimum of six times at intervals of approximately three minutes (pulse b only).

2-3.3.21.2 Communication, Control, and Monitor Line Transients.- Using pulses b, c, and d of Table I (2-3.3.21) the following transients shall be applied to each communication, control, and monitor line:

a. A single pulse applied a minimum of six times in succession. (Pulses b and c).

b. A single burst of pulses (consisting of a minimum of 40 pulses at a PRF of 10 Hz) applied a minimum of six times at intervals of approximately three minutes. (Pulse b only).

c. A single burst of pulses (consisting of a minimum of 40 pulses at a PRF of 100 Hz) applied a minimum of six times at intervals of approximately three minutes. (Pulse d only).

2-3.3.21.3 Spare Capacity.- The design of the transient protective equipment shall be such as to provide the capability for the future addition by the Government of protective devices for up to a total of four (4) pairs of communication lines or monitor lines or control lines or a combination thereof at any protected station."

Page 15, paragraph 2-3.4.3.1.6.- Change "DME/foot" to "DDM/foot".

Page 16, paragraph 2-3.4.3.2.1.- In the fifth line add a comma after "2.0 percent" and insert "carrier modulation by more than ± 1.0 percent".

Page 17, paragraph 2-3.4.3.2.3(c).- Following "carrier modulation" change "± 0.5% (each tone)" to read "± 1.0% (each tone)".

Page 17, paragraph 2-3.4.3.2.5.- In the first line change "channel determining" to "required".

Page 18, paragraph 2-3.4.3.2.12. In the last sentence change "structure" to "aligrment".

Page 18, paragraph 2-3.4.3.2.15.- Add "Adjustment of this control from the midrange setting over its full range shall not cause the amplitude to change more than $\pm$ 0.25 dB."

Page 19, paragraph 2-3.4.3.2.17.- Delete and substitute the following therefor:

"For test purposes, a minimum of two identical linear detectors for sampling the respective signals at the carrier output and sideband output shall be provided. The output of each of the linear detectors shall be a minimum of 300 millivolts into a 20K ohm load and shall be available at test jacks located on the modulator front panel."

Page 19, paragraph 2-3.4.3.2.19.- In the first sentence change "and Sideband Output front panel test jacks" to "front panel test jack and the sideband output when it is properly demodulated."

Page 20, paragraph 2-3.4.3.2.20.1.- After the third sentence delete existing text and substitute the following therefore: "Keying of the DME is accomplished by providing a short circuit at two terminals with a maximum resistance of 250 ohms. Current through the terminals shall not exceed 20 ma and the open circuit voltage shall not exceed 50 V DC. DME keying shall not be affected by operation of the localizer keyer switch (2-3.4.3.2.20)".

Page 20, paragraph 2-3.4.3.3.- Delete seventh sentence and substitute the following therefor:

"The antenna systems shall be prefabricated and include radiating elements, radomes (if required), mounting bases and support posts, distribution network, in-line phasing detector, integral monitoring, monitor combining network and detection system, interconnecting R.F. cables, obstruction lights and A.C. power cables. The in-line phasing detector shall consist of an R.F. sampler and detection system, provided for permanent installation at the appropriate output of the distribution unit to enable the establishment and maintenance of the optimum carrier sideband to sideband only phase relationship in the array".

Page 21, paragraph 2-3.4.3.3.1.1(a).- In the third and fourth sentences delete "26 dB" and substitute "23 dB".

Page 21, paragraph 2-3.4.3.3.1.1(b).- In the second and third sentences delete "26 dB" and substitute "23 dB".

Page 21, paragraph 2-3.4.3.3.1.2(a).- In the second sentence delete "26 dB" wherever it appears and substitute "23 dB" therefor.

Page 22, paragraph 2-3.4.3.3.4.- In the last sentence delete "duplex" and substitute "exterior".

Page 23, paragraph 2-3.4.3.3.9.- Delete the existing text and substitute the following therefor:

"The isolation between those adjacent antenna elements in the array with the closest spacing as measured between the input connector of the driven element and the monitor output of the undriven element shall be at least 26dB."

Page 24, paragraph 2-3.4.3.4.- In seventh sentence delete the words "identification signal" and substitute "mechanical alignment, antenna feedline fault, and integral monitor feedline fault which shall each be provided with status indicator lights only".

Page 24, paragraph 2-3.4.3.4.1.- Add the following "After initial adjustment under normal test conditions, changes from the initial room temperature readings occuring between 3 seconds and fifteen minutes after initial application of power under each of steps 3, 6, and 8 of 1-4.12 of specification FAA-G-2100/1 (modifies 1-4.12 for this application) and throughout the remainder of the test shall not exceed 25 percent of the change from nominal to the alarm threshold specified in 2-3.4.3.4.2"

Page 25, paragraph 2-3.4.3.4.4.- In the first sentence delete the words "of the transmitter output characteristics".

Page 26, paragraph 2-3.4.4.1(a).- Change "modulation equipment" to "modulation and control equipment".

Page 28, paragraph 2-3.4.4.3.1.- Delete the period at the end of the paragraph and add the following "or the modulation percentage by more than 0.5 percent".

Page 29, paragraph 2-3.4.4.3.3(c) and (d).- Following "Carrier modulation" change "$\pm$ 0.5 percent (each tone)" to read "$\pm$ 2.0 percent (each tone)"; following "carrier modulation balance" change "$\pm$ 0.01 DDM" to read "$\pm$ 0.015 DDM".

Page 29, paragraph 2-3.4.4.3.5. Delete "channel determining" and substitute "required".

Page 30, paragraph 2-3.4.4.3.15.- Add the following "Adjustment of this control from its midrange setting over its full range shall not cause the amplitude to change more than ± 0.25 dB".

Page 30, paragraph 2-3.4.4.3.17.- Delete and substitute the following therefor:

"For test purposes, a minimum of two identical linear detectors for sampling the respective signals at the carrier output, and sideband output shall be provided. The output of each of the linear detectors shall be a minimum of 300 millivolts into a 20 K ohm load and shall be available at test jacks located on the modulator front panel."

Page 30, paragraph 2-3.4.4.3.19.- In the first sentence change "and Sideband Output front panel test jacks" to "front panel test jack and sideband output when it is properly demodulated".

Page 31, paragraph 2-3.4.4.3.20.3.- Add the following:

"Additionally, a switch shall be provided to allow removal of the clearance signal independent from the reference transmitter while not interfering with normal monitoring".

Page 32, paragraph 2-3.4.4.3.20.7.- In the first sentence change "channel determining" to "required".

Page 32, paragraph 2-3.4.4.4.1.- Add the following "Adjustment of this control from its midrange setting over its full range shall not cause the amplitude to change by more than ± 0.25 dB".

Page 33, paragraph 2-3.4.5.1.- Delete and substitute the following therefor:

"Phasers shall be provided in each of the antenna outputs. At the contractor's option these phasers may be either an integral part of the APCU or external to the APCU assembly. If the phasers are external to the APCU assembly, they shall be mounted in the external RF network of 2-3.4.4.6.12. Each phaser shall have an electrical range of adjustment of at least 35 degrees each side of midscale and a mechanical range of at least 1.5 inches of linear travel or 40 degrees of rotational travel each side of midscale. At the output of the APCU, the phase of the upper antenna shall be in phase (± 5.0 degrees) with respect to the lower antenna output and simultaneously out of phase (180 ± 5 degrees) with respect to the middle antenna when a signal is fed to the sideband input. If the phasers are an integral part of the APCU, this requirement shall be met with all phasers set to midscale. Adjustment of these phasers from the midrange setting over their full range shall not vary any output level of the APCU by more than ± 0.1 dB. The APCU shall be designed to allow adjustment of the carrier sideband to sideband only phase in the middle antenna output independent of the carrier sideband to sideband only phase in the lower antenna output".

Page 33, paragraph 2-3.4.4.5.3.- In the third line, delete the phrase "the clearance input" and add the following new sentence: "The power at the clearance input shall be 33 dB or more below the incident power applied to the carrier input."

Page 35, paragraph 2-3.4.4.6.8.- At the end of the first sentence delete the period and add the following: "and shall not decrease below -22 dB in the range from 20 degrees azimuth to 35 degrees azimuth."

Page 36, paragraph 2-3.4.4.6.16.- In the second sentence change "th" to "the" and "AC contractor" to "AC Contactor".

Page 37, paragraph 2-3.4.4.6.20.- In the first sentence delete "or (2) on wooden poles, provided the climber is protected from falling by the use of linesman's equipment during the entire time the climber is on the pole".

Page 37, paragraph 2-3.4.4.7.1(b).- Delete the words "either path" in the eighth line and substitute "the near field path".

Page 38, paragraph 2-3.4.4.7.1(c).- In the first sentence after the word "device" insert the phrase "meeting all failsafe requirements (2-3.4.4.7.4)".

Page 38.- Add the following new paragraph:

"2-3.4.4.7.1.1 Near field monitor.- The near field pickup device and tower for each type of glide slope system shall be provided as follows:

(a) Null reference glide slope station. The near field pickup device and tower shall be provided for location at a point in front of the glide slope antenna array calculated to be the 180, +0, -30 degree phase proximity point between the upper and lower antennas. The height of the near field pickup device shall be adjustable from 10 to 20 feet above ground level in order to facilitate final placement of the near field pickup device in the first null of the upper antenna. The near field monitor sensitivity shall be adjusted to indicate a fault condition if the signal from the near field pickup device exceeds that which would be produced by movement of the near field pickup device $\pm$ 0.2 degrees from its nominal height.

(b) Sideband reference glide slope station. The near field pick up device and tower shall be located on a rectangular, elevated screen counterpoise in order to minimize effects of changing ground conditions. The screen counterpoise shall extend from the glide slope antenna array to a point a minimum of 12 feet behind the near field pickup device and a minimum of 6 feet either side of the monitor pickup device. The screen counterpoise shall be provided as specified in the invitation for bids or requests for proposals. Documentation for the screen counterpoise is to be furnished in accordance with

2-3.3.19. The near field pickup device and suitable tower shall be provided for location at a point in front of the glide slope antenna array determined to be the 300 ± 5 degree phase proximity point between the upper and lower antennas. The near field pickup device shall be positioned at a height to place it at the peak of the first lobe of the upper antenna. To facilitate adjustment the height shall be adjustable from 2 feet to 8 feet above ground level and the longitudinal positioning of the near field pickup device and tower shall be adjustable by means of rails or other sliding assemblies over a 10 foot range. The near field monitor sensitivity shall be adjusted to indicate a fault condition if the signal from the near field pickup device exceeds that which would be produced by dephasing of the upper antenna to an out-of-tolerance condition (2-3.4.4.7.3).

(c) Capture effect glide slope station. The near field pickup device and tower shall be provided for location at a point in front of the glide slope antenna array determined to be the 360 ± 5 degrees phase proximity point between the upper and lower antennas. The height of the near field pickup device shall be adjustable from 10 to 30 feet above ground level in order to facilitate placement of the near field pickup device in the first null of the middle antenna. The near field monitor sensitivity shall be adjusted to indicate a fault if the signal from the near field pickup device exceeds that which would be produced by movement of the near field pickup device ± 0.2 degrees from its nominal height or that which would be produced by attenuation to an out-of-tolerance condition (2-3.4.4.7.3) of the signal feeding the upper antenna.

Page 38, paragraph 2-3.4.4.7.2.- Add the following "After initial adjustment under normal test conditions, changes from the initial room temperature readings occurring between 3 seconds and fifteen minutes after initial application of power under each of steps 3, 6, and 8 of 1-4.12 of specification FAA-G-2100/1 (modifies 1-4.12 for this application) and throughout the remainder of the test shall not exceed 25 percent of the change from nominal to the alarm threshold specified in 2-3.4.4.7.3."

Page 39, paragraph 2-3.4.4.7.4.- In the fifth line delete the words "of the transmitter output characteristic".

Page 39, paragraph 2-3.4.5(b).- Delete "to a wood pole meeting requirements herein specified" and substitute "to the steel tower".

Page 39, paragraph 2-3.4.5.- Add the following "(e) steel antenna support tower".

Page 40, paragraph 2-3.4.5.1.1.- In the last sentence delete all text after the word "requirements".

Page 40, paragraph 2-3.4.5.2.2.1.- Delete the second and third lines and substitute "normal output power from not less than 2.5 watts to no more than 0.05 watts."

Page 42, paragraph 2-3.4.5.4.- In the fourth line delete all text after "or is damaged".

Page 42, paragraph 2-3.4.5.4.4.- Between the first and second sentences insert the following new text. "Following a monitor initiated shutdown or restoration of primary A.C. power an automatic attempt at restart shall occur at (50) fifty seconds ± 5 seconds after shutdown and again at 15 minutes ± 30 seconds after the initial shutdown if the first attempt is unsuccessful. If either restart attempt is successful the restart circuitry shall automatically return to the full enable state. If the station is still inoperative after two attempts at restart, no further automatic attempts at restart shall be made.

Page 43, paragraph 2-3.4.5.7.- Delete the present title and text and substitute "Not used" therefor.

Page 45, paragraph 2-3.4.8.1(a).- In the second sentence change "voltage" to "signal".

Page 45, paragraph 2-3.4.8.1(g), (h) and (i).- Delete the existing text in its entirety and substitute the following therefor:

(g) Inclusion of a two terminal input, one terminal of which is a positive voltage supply not to exceed 50 volts for the purpose of interlocking the Instrument Landing System with equipment not to be supplied under this specification. A contact closure between the two terminals with a resistance of less than 350 ohms shall cause the main equipment of the localizer, the glide slope and each of the marker beacon stations to energize after a 20 ± 4 second delay. An open circuit with a resistance greater than 10,000 ohms shall cause all transmitting equipment of the localizer, glide slope and each marker beacon station to shutdown without delay.

(h) Inclusion of two spare monitor channels identical to those supplied for the marker beacon stations. The two spare monitor channels shall provide visual indication of the status of two alarm relay contacts supplied by equipment not to be furnished under this specification. The two alarm relay contacts shall be located at the localizer and outer marker beacon station respectively. A contact closure at the remote site supplied by equipment not to be furnished under this specification with a resistance less than 350 ohms shall result in activation of the green "normal" light of the appropriate channel; an open circuit with a resistance greater than 10,000 ohms shall result in activation of the red "alarm" light.

(i) Not used."

Page 46, paragraph 2-3.4.8.2(d).- delete in its entirety and substitute "Not used."

Page 46, paragraph 2-3.4.8.2(e).- delete it its entirety and substitute "Not used".

Page 46, paragraph 2-3.4.8.3.- delete and substitute the following:

"The remote monitoring and control functions shall be accomplished utilizing tones of 2225 ± 5 Hz and 2025 ± 5 Hz originating from the control unit and 1270 ± 5 Hz and 1070 ± 5 Hz originating from the localizer, glide slope or middle marker stations in a duplex operation over a single voice-grade balanced telephone line pair (not supplied under this specification) originating at each remote site and terminating at the control point. The output amplitude of the tones shall be adjustable from -30 dbm to + 6 dbm with a nominal impedance of 600 ohms. Requirements shall be met over the complete range of adjustment."

Page 46, paragraph 2-3.4.9.- delete the period at the end of the first sentence and insert the following:

"as specified in the invitation for bids or request for proposals and as further specified herein. Crystals for the receiver shall be furnished with the transmitters in accordance with 2-3.4.3.2.5 and 2-3.4.4.3.5."

Page 48, paragraph 2-3.5.1.4.- Delete "Rain up to 4 inches per hour" and substitute "Driving rain: 4 inches per hour striking equally the walls and roof of the shelter".

Page 50, paragraph 2-3.5.2.7.- In the second line delete the words "equal to".

Page 50, paragraph 2-3.5.2.11.- Add the following new text "The shelter door shall be provided with a stop chain or bar to prevent possible damage to shelter or door from wind gusts.

Page 51, paragraph 2-3.5.3.1.- In the eighth line delete "Regrigerating" and substitute "Refrigerating".

Page 52, paragraph 2-3.5.3.4.- In the second sentence delete "gravity shutters" and substitute "motor operated louvers". In the last sentence delete "the intake openings".

Page 53, paragraph 2-3.5.4.3.- In the first sentence change "AC 70/7460-1A" to "AC 70/7460-1". Delete the third sentence in its entirety. In the fourth sentence delete "Joslyn # 1235-01" and substitute "Joslyn # 1265-04" therefor.

Page 53, paragraph 2-3.5.4.5.- Delete first sentence and substitute the following: "A 120 volt single phase 20 amp five (5) receptacle plug in strip outlet shall be provided above the workbench.

Page 53, paragraph 2-3.5.4.6.- In the last sentence delete "RE-7S2G" and substitute "RE-7P2G".

Page 54, paragraph 2-3.5.4.8.- Add the following:

"All conduits including adapters, connectors and mounting hardware required to provide interface from the shelter to the antenna array or to external junction boxes or to antenna towers including that required for the towers themselves shall be provided as part of the equipment to be furnished under this specification. The conduit kit furnished for each glide slope near field monitor tower (2-3.4.4.7.1(b)) shall include a weather proof exterior convenience receptacle with the necessary mounting hardware. All conduit to be furnished under this requirement shall be identified and indicated on the drawings to be prepared and submitted in accordance with 2-3.5.5.1 and 2-3.5.5.3."

Page 54, add the following new paragraph.- "2-3.5.4.10 Ground - to Air Communication Antenna. A ground-plane antenna suitable for VHF ground to air communications at 136 MHz shall be provided with each shelter, including cable, preinstalled mounting bracket, and preinstalled conduit for routing the antenna cable to the inside of the shelter above the workbench. The antenna shall have a nominal impedance of 50 ohms, an input standing wave ratio less than 2.0, and a gain greater than 3 dB."

Page 54, paragraph 2-3.5.5.1(b).- Delete "Design/fabrication" and substutute "Design".

Page 56, paragraph 2-3.6.- Delete the first sentence, and substitute the following therefor:

"A portable ILS receiver designed in accordance with Specification FAA-E-2356 shall be furnished as part of each ILS system as specified in the invitation for bids or request for proposals and as further specified herein, with the exception that a Type III system shall not include equipment items (d) antenna assembly, glide slope, (e) interconnecting cables and adapters and (g) tripod and mast assembly. Crystals for the receiver shall be furnished with the transmitters in accordance with 2-3.4.3.2.5 and 2-3.4.4.3.5."

Page 56, paragraph 2-3.7.- Delete the period at the end of the first sentence and add the following: "as specified in the invitation for bids or requests for proposals and as further specified herein."

Paragraph 2-3.8.- In the fifth line and in the eleventh line delete the words "a Type A equipment book per paragraph 3.18 of FAA-D-2494/1" and in each place substitute "an equipment instruction book in accordance with Specifications FAA-D-2494/1 and FAA-D-2494/2."